REMARKS

Claims 1-7 have been rejected under 35 U.S.C. § 103(a) over JP 7-51927 (JP '827) in view of JP 9-108805 (JP '805).

JP '827 discloses a method of producing a low melting point metal product. A heating cylinder 4 includes a plunger cylinder 5 having an injection bore 11 located at the tip. A furnace 21 is located at the upper portion in the middle. A cylindrical screw 2, having flights provided at a certain interval as known in the art, is arranged to be freely rotatable inside the cylinder. A plunger 6 is provided in the screw for back and forth movement. A driver 3 is provided for the screw and the plunger 6. These elements configure an injection machine 1, which is located horizontally at a cylinder press 70 such that the injection bore 11 at the tip is press-contacted with a stationary mold 61. A molten metal supplied from the furnace 21 to the cylinder 4 is transferred to the tip by rotation of the screw 2. During the transfer, the temperature is retained above the solidus temperature and below the liquidus temperature to keep the molten metal in a solid/liquid mixed state, which is agitated by frictional contacting. During the process of solidifying, dendritical crystals are produced in a thixotropical form and stored in the cylinder tip. The plunger 6 moves back in accordance with an increase in the stored amount.

Thus, a certain amount can be stored (weighed) in a space between the plunger 6 and the cylinder 5.

JP '805 discloses an apparatus for injection molding a semisolid metal. A front ball screw 3 and a rear ball screw 7 are arranged to support a base 2 at the front and rear ends and configured to change the angle of the base 2 from the horizontal state to an inclined state. An injection cylinder 17 contains a screw shaft 21 for agitating and sending a pulverized material to a mold 40. The injection cylinder 17 and a motor 22 for rotating the screw shaft, together with a plunger cylinder 23, form an injection molding machine 36, which is mounted on the base 2. A nozzle member 18 is located at the tip of the injection cylinder 17 and nozzle-touched to the mold 40. Heating, agitating and weighing/storing of the supplied pulverized material are performed while rotating the screw shaft 21 in the horizontal state. Injection molding is performed in the inclined state such that the half-molten, semisolid metallic slurry weighed by screw rotation is injected into the mold 40 by screw advancement to yield a metallic product.

The Examiner asserts that it would have been obvious to modify the apparatus of JP '827 to add the variably inclined injection mechanism and sealing ring of JP '805 to achieve

accurate weighing of the molten material and to prevent material infiltration to the rear part of the screw shaft. As noted above, however, in JP '805, rotation of the screw shaft to supply material, agitation, and weighing/storing is performed when in the horizontal state. Only injection molding is performed in the inclined state. In contrast, claim 1 of the present invention recites that the melting cylinder is provided obliquely with a tip portion end directed downwardly such that a molten metal in said melting cylinder flows down by self-weight to be stored in the tip portion. Thus, even if the teachings of JP '805 were combined with JP '827, the presently claimed invention would not result.

Furthermore, in the present invention, the melting cylinder fully melts the metallic material to retain it in a molten state (liquid phase). To the contrary, the injection cylinder in JP '805 sends the metallic material still in the half-molten, semisolid state to the cylinder tip for weighing by rotation of the screw shaft while still in the horizontal configuration. Thus, JP '805 differs in configuration from the present invention, in which the nozzle member is directed downwardly such that the molten metal in the injection mechanism flows down by self-weight to be stored in the tip portion and weighed in the stored state. Thus, the downwardly directed nozzle member operates differently and yields

a different effect from JP '805. Accordingly, the presently claimed invention is believed to be patentable over JP '827 in view of JP '805.

Additionally, claim 1 of the present invention also recites a plurality of agitating wings formed intermittently about an outer periphery of a tip portion of the hollow shaft. In contrast, in JP '827 (and in JP '805), the agitating member is a continuous screw, not intermittent wings. The screw of JP '827 enables the molten metal to be transferred and partly solidified during the transfer and to be broken and finely spheroidized by shearing action. Thus, the presently claimed invention is distinct form JP '827 for this reason as well. It is difficult for the screw of JP '827 in an extremely short time to melt the metallic material in the form of particles stored in the melting cylinder and dropped in the molten bath even when the metallic material is mixed in the bath by the agitating wings to melt it with the heat from the molten bath.

Also, although JP '827 describes that material is mainly stored in the plunger cylinder 5, weighing is performed between the plunger cylinder 5 and the plunger 6 that moves back in accordance with an increase in the stored amount. Accordingly, the plunger cylinder 5 does not correspond to the weighing chamber of the present invention.

Further, in JP '827, weighing is performed when the screw tip and the plunger cylinder are separated from each other, and injection is performed when they are contacted tightly with each other to prevent reverse flow. (This is described with reference to Figs. 1 and 2 at page 7, line 2 from the bottom left column to line 6 in the right column.) Thus, even if the injection machine described in JP '827 were directed downwardly based on JP '805, the molten metal flowing down by self-weigh to be stored in the tip portion of the melting cylinder could not be achieved as in the present invention.

In JP '827 and JP '805, molten metal is transferred by screw rotation to the cylinder front at every step of injection molding and subjected to agitating/shearing for semi-solidifying and weighing. In the present invention, in contrast, molten metal in the liquid phase is stored in the tip portion of the melting cylinder. The molten metal is then absorbed through the sliding clearance, so that an amount for one shot for injection is weighed when the plunger moves back within the weighing chamber formed with a reduced diameter smaller than the inner diameter of the melting cylinder. Therefore, one skilled in the art would not find the presently claimed invention obvious in view of the descriptions in JP '827 and JP '805.

In view of the above remarks, all claims are believed to be in condition for allowance, and reconsideration and indication thereof are respectfully requested. The Examiner is encouraged to telephone the undersigned attorney to discuss any matter that would expedite allowance of the present application.

Respectfully submitted,

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